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**THE LIFE-AREAS OF SOUTHERN NEW JERSEY.**

BY WITMER STONE.

As pointed out by Verrill as early as 1866, the eastern United States is divisible into four main parallel faunal and floral belts or life-zones—the Canadian, Alleghanian, Carolinian and Louisianian (or Austro-riparian). While the general trend of these belts is east and west they are greatly deflected by the Appalachian mountain chain, so that in eastern Pennsylvania and New Jersey they run more nearly northeast and southwest.

The Canadian zone is limited to the higher parts of the mountains in Pennsylvania, often mere isolated islands, present in New Jersey only in the northwestern corner of the State—if at all; the Alleghanian occupies the greater part of Pennsylvania and the northern third of New Jersey, while the Carolinian is restricted to the southeastern and southwestern corners of Pennsylvania and central and southern New Jersey.

This would represent roughly the relative position of the three life-zones in these States based upon a study of the birds and mammals, though the exact boundaries are hard to trace, owing in part to the gradual passage of one fauna into the other, the overlapping of the ranges of certain species and the constant changes that are being effected by the destruction of the forests.

These belts may be subdivided into minor areas dependent upon peculiar climatic, topographic or geologic conditions.

The study of the distribution of the various species of terrestrial vertebrates is often of little aid in defining these minor life-areas, because the conditions that produce them are not sufficiently potent to act as barriers to the ranges of such free-moving forms.

Plants, however, are far more susceptible to these influences and their great wealth, both of species and individuals, offers an enormous amount of data to any one engaged in studying the boundaries of minor life-areas.

Consequently in the study of the life-areas of southern New Jersey, in which I have been engaged for a number of years, I have paid especial attention to plants, though I have of course taken advantage of any other data that were available.

While I contemplate a much fuller and more exhaustive treatment of the subject in the future, it seems desirable to present at once some of the conclusions to which my studies have led. It would seem that those portions of eastern Pennsylvania and New Jersey that we have been accustomed to refer to the Carolinian zone are divisible into several areas running in a general northeast and southwest line parallel to the mountains:

I. A hilly or rolling country adjoining the Alleghanian on the west and north and reaching east and south to the flat bottom of the lower Delaware Valley and the old Raritan basin.

II. The Delaware Valley–West Jersey region.<sup>1</sup>

III. The Pine Barrens.

IV. The Atlantic Coast strip, including the higher parts of the coast islands.

V. The Maritime meadows and sea beach.

It is with the three middle divisions that this paper has to deal—the Pine Barrens, the Delaware Valley and Coast Strip.

The greater part of southern New Jersey is composed of what is known as the Pine Barren region, covering according to current views all the country east and south of a line from Long Branch to Bridgeton.

The flora of the Pine Barrens is very uniform with relatively few species, but generally so different from that of the area to the west that the passage from one to the other is easily noticeable even from a moving railway train. Indeed I am not acquainted with any transition so striking elsewhere in the Middle States. The West Jersey flora is identical with that of the low grounds on the Pennsylvania side of the Delaware at Tinicum, Bristol, Tullytown, and doubtless also of the lower part of Philadelphia when that was in a state of nature. This same flora extends northeastward across New Jersey above the Pine Barrens and south of the hilly region to the north. Indeed the resemblance between the plant life at Tinicum, Delaware Co., Pa., and from Monmouth Junction to Princeton Junction, N. J., is remarkable.

The flora of the New Jersey Pine Barrens has long been familiar to botanists, and the species of the south Atlantic coastal plain which here find their northern limit have for the most part been listed for

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<sup>1</sup> Plate XII in Salisbury's *Physical Geography of New Jersey*, 1898 (Vol. IV. *Final Rep. of State Geologist*), shows a remarkable correspondence with my floral areas. The area of Pensauken submergence being almost equivalent to my Delaware Valley and Coast regions, while the elevated Beacon Hill region is the typical Pine Barrens.

many years. A feature of the Pine Barren flora, however, quite as striking as the presence of these southern forms, and one upon which little stress has been laid, is the absence of very many widely distributed species.

In Dr. N. L. Britton's *Catalogue of Plants found in New Jersey* many common species are given as occurring "throughout the State" which are entirely absent from the Pine Barrens. Another point of interest is the fact that the Pine Barren flora does not cover the entire southeastern portion of the State. Along the whole seaboard back of the salt meadows is a strip of varying width supporting a flora essentially similar to that of West Jersey, and in the Cape May peninsula these eastern and western strips join together almost to the exclusion of the true Pine Barren flora, which occurs only in spots or islands south of the Great Cedar Swamp.

The southern portion of the Cape May peninsula, especially on the Delaware Bay side, harbors quite a number of plants that are distinctly more southern than those of the Pine Barrens, and would seem to constitute a tinge of the Austro-riparian zone, which normally reaches its northern limit at the Capes of the Chesapeake.

Some of these plants extend up into West Jersey and others up the eastern coast strip a varying distance, but none of them into the Pine Barrens.

Opposed to these two southern elements we have three boreal incursions into the southern New Jersey flora: First, certain bog species of the Pine Barrens; second, a number of northern species which occur in West Jersey, especially close to the edge of the Pine Barrens, and, third, species which occur in the coastal strip and in the wooded areas that are found here and there on the long narrow islands that form the true sea beach of eastern New Jersey, frequently separated by five or six miles of salt meadows or bays from the mainland.

While not attempting in the present connection to correlate these life-areas and boreal and austral incursions with conditions which may have produced them, I mention below some of the more characteristic species which distinguish them.

#### I. THE PINE BARRENS.

The characteristic trees of this region are in the dry portions *Pinus rigida*, *Quercus marylandica*, *Q. nana*, *Q. minor*, *Q. prinus*, *Q. prinoides*, *Sassafras sassafras*. In moist spots *Chamæcyparis thyoides*, *Nyssa sylvatica*, *Magnolia virginiana*, *Acer rubrum*, *Betula populifolia*. Characteristic shrubs are *Gaylussacia resinosa*, *G. frondosa*, *G. dumosa*,

*Vaccinium vascillans*, *V. corymbosum*, *Leucothoë racemosa*, *Xolisma ligustrina*, *Kalmia latifolia*, *K. angustifolia*, *Azalea viscosa*, *Clethra alnifolia*, *Viburnum nudum* and *Comptonia peregrina*.

While the above are the most conspicuous components of the flora, they are by no means confined to this area.

The following list includes the peculiar Pine Barren species and those which occur southward along the Atlantic coastal plane, but which find their northern limit in the New Jersey Pine Barrens. A few of them do occur, it is true, on Long Island, in colonies which seem to constitute northern pine barren islands. A few also occur in such spots in West Jersey, but in the main these species are absent from both West Jersey and the eastern coast strip, and in any case may be regarded as typical Pine Barren species.

<i>Lycopodium carolinianum</i>	<i>Gyrotheca tinctoria</i>
<i>Lycopodium alopecuroides</i>	<i>Arenaria caroliniana</i>
<i>Calamovilfa brevipilis</i>	<i>Ascyrum stans</i>
<i>Sporobolus torreyanus</i>	<i>Hypericum densiflorum</i>
<i>Panicum sphagnicola</i>	<i>Hypericum virgatum ovalifolium</i>
<i>Carex walteriana</i>	<i>Polygala lutea</i>
<i>Cyperus cylindricus</i>	<i>Polygala brevifolia</i>
<i>Rhynchospora torreyana</i>	<i>Meibomia stricta</i>
<i>Rhynchospora gracillenta</i>	<i>Itea virginica</i>
<i>Rhynchospora oligantha</i>	<i>Dendrium buxifolium</i>
<i>Rhynchospora pallida</i>	<i>Pyxidanthera barbulata</i>
<i>Rhynchospora knieskernii</i>	<i>Sabbatia lanceolata</i>
<i>Scleria torreyana</i>	<i>Gentiana porphyrio</i>
<i>Juncus marginatus aristulatus</i>	<i>Lobelia canbyi</i>
<i>Juncus cæsariensis</i>	<i>Lacinaria graminifolia pilosa</i>
<i>Xyris fimbriata</i>	<i>Eupatorium leucolepis</i>
<i>Tofieldia racemosa</i>	<i>Eupatorium resinosum</i>
<i>Abama americana</i>	<i>Sclerolepis uniflora</i>
<i>Xerophyllum aspideloides</i>	<i>Helianthus angustifolius</i>
<i>Smilax walteri</i>	<i>Aster gracilis</i>
<i>Smilax tamnifolia</i>	<i>Aster nemoralis</i>
<i>Smilax laurifolia</i>	<i>Solidago stricta</i>
<i>Blephariglotis cristata</i>	<i>Solidago fistulosa</i>
<i>Lophiola americana</i>	<i>Solidago erecta</i>

The northern element in the Pine Barren flora consists of the following species, which find their southern low ground limits in this region or a little to the south of it. Those marked with an asterisk are

peculiarly Pine Barren species, so far as southern New Jersey is concerned, not occurring in West Jersey or the coast strip.

<i>Schizæa pusilla</i> *	<i>Blephariglottis blephariglottis</i>
<i>Sporobolus serotinus</i> *	<i>Coreimna conradii</i>
<i>Carex livida</i>	<i>Utricularia clandestina</i>
<i>Carex folliculata</i>	<i>Gaultheria procumbens</i>
<i>Carex trisperma</i>	<i>Chamædaphne calyculata</i>
<i>Eriophorum polystachion</i>	<i>Arctostaphylos uva-ursi</i>
<i>Juncus pelocarpus</i>	<i>Vaccinium atrococcum</i>
<i>Juncus militaris</i>	<i>Chrysopsis falcata</i>
<i>Unifolium canadense</i>	

Among birds we find three species which breed regularly in the Pine Barrens but not in West Jersey, *i.e.*, *Dendroica vigorsii*, *D. discolor* and *Compsothlypis americana usneæ*. A number of species common in West Jersey are however absent from the Pines. Among mammals we have two species peculiar to the Pine Barrens, *Evotomys gapperi rhoadsi* and *Synaptomys cooperi*, both boreal incursions, and several West Jersey species which are absent, *i.e.*, *Sciurus carolinensis leucotis* and *Tamias striatus*.

## II. LOWER DELAWARE VALLEY REGION AND COAST STRIP.

West Jersey from Trenton southward, west and southwest of the Pine Barrens, supports a far greater variety of trees than the Pine Barrens. The most plentiful species, not found in the latter region, are *Pinus virginiana*, *Juniperus virginiana*, *Quercus phellos*\*, *Q. digitata*\*, *Q. platanoides*\*, *Q. coccinea*, *Castanea dentata*, *Fagus americana*, *Betula nigra*, *Ulmus americana*, *Hicoria alba*, *H. glabra*, *H. minima*, *Carpinus caroliniana*, *Liriodendron tulipifera*, *Platanus occidentalis*, *Diospyros virginiana*\*, *Cornus florida*, *Liquidambar styraciflua*\*, *Prunus serotina* and *Ilex opaca*.\*

Those marked with an asterisk are not found on the hilly country which begins just west of the Delaware, nor north of the low ground between Trenton and the Raritan.

In this West Jersey district too we meet with many plants common to the Pine Barrens but which do not extend farther north or west. Such as

<i>Woodwardia areolata</i>	<i>Euphorbia ipecacuanæ</i>
<i>Woodwardia virginica</i>	<i>Gerardia purpurea</i>
<i>Iris prismatica</i>	<i>Eupatorium maculatum</i>
<i>Lilium superbum</i>	<i>Eupatorium album</i>
<i>Polygala nuttalli</i>	<i>Eupatorium rotundifolium</i>
<i>Rhexia mariana</i>	<i>Euthamia caroliniana</i> , etc.

There are also a great number of plants common to this region and the upland and not found in the Pine Barrens. The difference in the flora of the two regions, as already stated, is due quite as much to the absence of these plants as to the presence of peculiar southern species.

A few of the commoner members of this group are

<i>Spathyema fœtida</i>	<i>Viola papilionacea</i>
<i>Arisæma triphyllum</i>	<i>Viola sagittata</i>
<i>Erythronium virginicum</i>	<i>Asclepias pulchra</i>
<i>Anemone nemorosa</i>	<i>Lobelia cardinalis</i>
<i>Ranunculus abortivus</i>	<i>Hieracium giganteum</i>
<i>Ranunculus fascicularis</i>	<i>Eupatorium purpureum</i>
<i>Ranunculus recurvatus</i>	<i>Eupatorium perfoliatum</i>
<i>Thalictrum polygamum</i>	<i>Vernonia noveboracensis</i>
<i>Caltha palustris</i>	<i>Senecio aureus</i>
<i>Viola cucullata</i>	

The narrow Atlantic coast strip has practically the same flora as the lower Delaware Valley, though many of the trees are absent.

The northern incursions into this flora are as follows, most of them local and some of them rare:

In West Jersey:

<i>Filix fragilis</i>	<i>Vaccinium pennsylvanicum</i>
<i>Actæa alba</i>	<i>Rhododendron maximum</i>
<i>Polygonum careyi</i>	<i>Illicioides mucronata</i>
<i>Pyrola secunda</i>	<i>Pedicularis lanceolata</i>
<i>Pyrola chlorantha</i>	

In Bogs:

<i>Carex fusca</i>	<i>Scheuchzeria palustris</i>
<i>Menyanthes trifoliata</i>	

On the Coast Strip:

<i>Sevastana odorata</i>	<i>Limosella tenuifolia</i>
<i>Triglochin maritima</i>	<i>Trientalis americana</i>
<i>Sabbatia angularis</i>	<i>Lacinaria spicata</i>

On the Coast Islands:

<i>Geranium robertianum</i>	<i>Salmonia stellata</i>
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Among southern species which reach the lower Cape May peninsula and push northward either in West Jersey or along the coast strip may

be mentioned the following. Most of these do not range north of New Jersey; those marked with an asterisk not north of southern Cape May county. None of them are Pine Barren species.

<i>Chætochloa magna</i> *	<i>Quercus michauxii</i>
<i>Brachiaria digitarioides</i> *	<i>Blephariglottis peramæna</i>
<i>Paspalum glabratum</i> *	<i>Juncus setaceus</i>
<i>Sacciolepis gibba</i> *	<i>Kosteletzkya virginica</i>
<i>Sporobolus asper</i>	<i>Silene pennsylvanica</i>
<i>Aristida lonosa</i>	<i>Hypericum gymnanthum</i>
<i>Erianthus compactus</i>	<i>Hypericum adpressum</i>
<i>Andropogon argyræus</i>	<i>Euonymus americanus</i>
<i>Eleocharis ochreate</i> *	<i>Gratiola pilosa</i> *
<i>Eleocharis melanocarpa</i>	<i>Tecoma radicans</i> *
<i>Rynchospora corniculata macros-</i>	<i>Diodia virginiana</i> *
<i>tachya</i>	<i>Lobelia puberula</i>
<i>Rynchospora rariflora</i> *	<i>Eupatorium cælestinum</i> *
<i>Gymnadeniopsis nivea</i> *	<i>Willoughbæya scandens</i>
<i>Castanea pumila</i>	<i>Senecio tomentosa</i> *

The fact that we have in the West Jersey area a number of birds and mammals not found in the Pine Barrens has already been alluded to. We have also certain species which correspond to the northern and southern elements just spoken of in treating of the plants. *Zamelodia ludoviciana* and *Empidonax minimus* both breed occasionally as far south as Camden county, while in Cape May and southwestern Burlington counties we have the only recorded nesting of *Polioptila cærulea* in the State. In lower Cape May we also have record of the occurrence of *Mimus polyglottos*, *Centurus carolinensis* and *Lanius ludovicianus*, while *Quiscalus major* has occurred once on the coast strip.

The lower part of West Jersey too marks the northern limit of *Oryzomys palustris*.

While the land and fluviatile mollusks of such a sandy country as southern New Jersey are necessarily not abundant, Dr. H. A. Pilsbry tells me that such species as occur on the east coast strip are depauperate forms of northern types, while in the southwestern part of Cape May county he has found *Succinea campestris vagans* and *Bifidaria hordeacella*, southern forms not recorded from elsewhere in New Jersey. The former is a race of *Succinea campestris* of Georgia and Florida, while the latter is not known elsewhere north of the same States.

Among insects, distributions have not, as a rule, been sufficiently

well worked out to warrant their use in defining minor life-areas. In the Orthoptera, however, Mr. J. A. G. Rehn tells me that certain species seem to conform quite well to the regions I have defined above. *Orphulella olivacea*, *Clinocephalus elegans* and *Chorthippus curtipennis* are found along the coast strip but not in the Pine Barrens, while *Chlœaltis conspersa*, *Paroxya scudderi*, *Melanoplus impudicus*, and *M. stonei* are restricted to the latter region.

In West Jersey there are a number of species common to the hilly region to the north and west and unknown in the Pine Barrens, just such a condition as we find among the plants.

## DECEMBER 3.

ARTHUR ERWIN BROWN, Vice-President, in the Chair.

Eighteen persons present.

Mr. William S. Vaux reported his observations made during the past summer on the glaciers of British Columbia.

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DECEMBER 17.

The President, SAMUEL G. DIXON, M.D., in the Chair.

Thirty-three persons present.

The following were ordered to be printed :